

FLUIDS

In-Class Example Problems

DENSITY & PRESSURE:

1. A sample of a certain substance has a mass of 280g and a volume of 0.00015m^3 . What is the mass of a 0.025m^3 sample of this same substance?
2. What pressure is exerted on the floor by a 75kg man standing on two feet, if each of his feet is 250cm^2 ?

FLUID PRESSURE:

3. How much force does the atmosphere exert on an area of 3km^2 ?
4. How much force is acting on a circular window of a submarine that dives to 1.5km below sea-level, if the window has a diameter of 40cm?
5. What depth of mercury would exert the same pressure as a 10m-depth of fresh water?

PASCAL'S PRINCIPLE:

6. In a car lift, compressed air exerts a force on a piston with a radius of 13cm. This pressure is transmitted to a second piston with a diameter of 1.04m. What force must the compressed air exert to lift a 1.2×10^4 N car?

ARCHIMEDES' PRINCIPLE:

7. A scale shows a sample of aluminum to have a mass of 250g (when measured in air). When the sample is submerged in water, it will obviously appear to have a lower mass, because the buoyant force will be helping to hold it up. Find the sample's apparent mass when submerged in water.

8. An object of unknown material weighs 520N in air. When suspended in water, it seems to weigh 400N. Find the volume and the density of the object.

FLOATING:

9. The density of a certain object is 630kg/m^3 , and that of ethyl alcohol is 790kg/m^3 . Will this object float in a container full of alcohol? If it does float, what fraction of the object will be submerged while floating?
10. An empty rubber balloon has a mass of 0.015kg . The balloon is filled with helium at a density of 0.181 kg/m^3 , and at this density the balloon is spherical with a radius of 0.3m . When the balloon is released, how fast does it accelerate upwards in the air?

CONTINUITY EQUATION:

11. A cowboy at a dude ranch fills a rectangular horse trough that is 1.5m long, 60cm wide, and 40cm deep. He uses a 20cm -diameter hose from which water emerges at 1.5m/s . How long does it take him to fill the trough?

BERNOULLI'S EQUATION:

12. Water is flowing through a vertical pipe that narrows from a 10cm to a 7cm diameter. Determine the pressure in the smaller part of the pipe, 5cm above the wider part of the pipe, assuming pressure and speed in the wide part of the pipe are 1.5×10^5 Pa and 2m/s, respectively.

13. At what speed does water exit a small hole at the bottom of a large 5-foot deep above-ground swimming pool?

14. A road sign has a bent pole, so that the face of the sign is oriented parallel to the road. If the sign has an area of 0.7m^2 , how much net force will act on it when it is passed very closely by a truck moving at 20m/s?